contrast, via 310 provides for an interconnection between components disposed on three surfaces (i.e., surfaces 302b, 302c and 302d).

II. Printed Inductors

[0042] As described above, conventional printed inductors employ a single layer approach. FIG. 4 is a top view of an exemplary single layer inductor 400. Single layer inductor 400 includes a conductive trace 406 having a meander pattern. At each end of conductive trace 406 are terminals 402 and 404, respectively. These terminals provide areas for the interconnection of inductor 400 with other electronic components (not shown).

[0043] Single layer inductor 400 requires a surface area on a single substrate surface that is shown in FIG. 4 as a footprint 408. As set forth above, single layer printed inductors have the disadvantage of requiring large footprints.

[0044] FIG. 5 is an illustration of a multiple layer inductor 500 that advantageously enables smaller footprint implementations. Multiple layer inductor 500 is implemented on a substrate having a plurality of layers that each have a corresponding surface. As shown in FIG. 5, this multiple layer substrate has a first surface 530 that corresponds to a first layer 540, a second surface 532 that corresponds to a second layer 542, and a third surface 534 that corresponds to a third layer 544.

[0045] Inductor 500 includes a first spiral conductive pattern 510, a second spiral conductive pattern 512, a continuing interconnection 514, an interface 502, an optional conductive bottom shield pattern 516, and an optional conductive top shield pattern 518.

[0046] Spiral conductive pattern 510 and interface 502 are both disposed on first surface 530. Interface 502 includes a first terminal 504 and a second terminal 506. Spiral conductive pattern 510 is electrically coupled to second terminal 506 and continuing interconnection 514. Terminals 502 and 504, as well as

conductive pattern 510 include conductive material(s) that are disposed on surface 530 through a printing process.

[0047] Spiral conductive pattern 512 is disposed on second surface 532. Spiral conductive pattern 512 is electrically coupled to first terminal 504 and continuing interconnection 514. Like first spiral conductive pattern 510, second spiral conductive pattern 512 includes conductive material(s) that are disposed on surface 530 through a printing process.

[0048] Continuing interconnection 514 provides an electrical interconnection between spiral conductive patterns 510 and 512. In addition, continuing interconnection 514 may also provide additional spiral conductive patterns. Various implementations of continuing interconnection 514 are described below in greater detail with reference to FIGs. 6A-8.

[0049] Conductive bottom shield pattern 516 is disposed on third surface 534. Surface 534 is adjacent to surface 532. Shield pattern 516 has a voltage potential, such as ground. Shield pattern 516 provides a shielding function that reduces unwanted electromagnetic interaction between inductor 500 and other electronic components (not shown).

[0050] Conductive top shield pattern 518 is disposed on fourth surface 536. Surface 536, which corresponds to a layer 546, is adjacent to surface 530. Shield pattern 518 has a voltage potential, such as ground. Shield pattern 518 provides a shielding function that reduces unwanted electromagnetic interaction between inductor 500 and other electronic components (not shown).

[0051] The aforementioned elements of multiple layer inductor 500 are within a footprint 508. FIG. 5 shows footprint 508 as a surface area projected onto each of surfaces 530, 532, 534, and 536. Footprint 508 is smaller than footprints associated with conventional single layer inductors.

[0052] The description now turns to various exemplary implementations of multiple layer inductor 500. FIGs. 6A and 6B are views of a three layer implementation of spiral inductor 500. In this implementation, continuing interconnection 514 includes a first via 602 and a second via 604. FIG. 6A,

which is a top view, illustrates that first via 602 provides a connection between first conductive pattern 510 and second conductive pattern 512. FIG. 6A also shows that second via 604 electrically couples second conductive pattern 512 with first terminal 504 of interface 502.

[0053] FIG. 6B is a side view of this three layer implementation that illustrates the relationship of inductor 500 components to surfaces in a multiple layer substrate. As shown in FIG. 6B, first conductive pattern 510 and interface 502 are disposed on first surface 530. First via 602 provides an electrical coupling between first conductive pattern 510 and second conductive pattern 512. Second via 604 provides an electrical coupling between second spiral conductor 512 and first terminal 504.

[0054] Shield pattern 516 is disposed on third surface 534, which is adjacent to surface 532. Shield pattern 516 is substantially aligned with second conductive pattern 512.

[0055] Implementations of multiple layer inductor 500 may include additional spiral conductive patterns. Accordingly, FIGs. 7 and 8 are views of an exemplary multiple layer inductor 500 implementation where continuing interconnection 514 includes multiple spiral conductive patterns.

[0056] FIG. 7 is a side view of an exemplary five layer implementation of inductor 500. In this implementation, continuing interconnection 514 includes two spiral conductive patterns that are each disposed on a corresponding substrate surface. These conductive patterns are shown in FIG. 7 as patterns 704 and 708, which are disposed on surfaces 730 and 732, respectively.

[0057] Continuing interconnection 514 also includes vias 702, 706, 710, and 712. Vias 702 and 710 provide electrical couplings between continuing interconnection 514 and conductive patterns 510 and 512, respectively. In particular, via 702 electrically couples spiral conductive patterns 510 and 704, while via 710 electrically couples spiral conductive patterns 512 and 708. Within continuing interconnection 514, via 706 electrically couples conductive patterns 704 and 708, while via 710 electrically couples conductive patterns 708 and 512.